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School Mask Mandates and Student SARS-CoV-2 Infections: Evidence from a Natural Experiment of Neighboring K-12 Districts in North Dakota, USA

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Abstract

Objective: To assess student COVID-19 case rates in two neighboring kindergarten-12th grade (K-12) school districts while one district had a mask mandate and the other did not and then while both did not have a mandate.

Design: Prospective natural experiment with partial crossover period to identify differences in baseline COVID-19 case rates while district mask polices were the same. Setting: Two adjacent school districts in Fargo, ND, during the 2021-2022 academic year. Study population: K-12 students in West Fargo and Fargo Public School districts. Intervention: Mask mandates for students and staff in Fargo Public School districts from 8/26/2021 through 1/17/2022.

Main outcome measures: COVID-19 student case rates and incidence rate ratio (IRR) for case rates between the districts while the districts had different and the same masking polices. Results: District student populations were not significantly different with respect to demographics, socioeconomic status or testing strategies. We observed no significant difference between student case rates while the districts had differing masking policies (IRR 0.99; 95% CI: 0.92 to 1.07) nor while they had the same mask policies (IRR 1.04; 95% CI: 0.92 to 1.16). The IRRs across the two periods were also not significantly different ($p = 0.40$). Based on an incidence rate of 13%, we had 80% power to detect a 1.2 percentage point difference in incidence.

Conclusion: Primary and secondary school mask mandates of the nature and setting described in the Fargo public schools were not found to be associated with lower student COVID-19 case rates.

Key words: COVID-19, SARS-CoV-2, mask mandates, natural experiment, prospective observational study, partial crossover

Disclosures, Funding & Conflicts of Interest:
None

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1 - Introduction

School districts across the world implemented mask mandates for children in the hope of reducing COVID-19 transmission, but the impact of school-based mask mandates on COVID-19 transmission in children continues to be a topic of debate. While observational studies of school mask mandates have had conflicting results,[1,2,3,4,5,6,7,8,9] randomized studies have failed to detect an impact of masking for COVID-19 on participants under 50 years of age and the trial from Bangladesh[10] reporting modest efficacy of surgical masking on those over 50 years has important biases which render this finding uncertain.[11] Pooled results from randomized studies of medical or surgical grade masks for respiratory viruses in the community have been negative, though the level of certainty is low to moderate.[12] Here we report the results of a prospective observational study of two large kindergarten-12th grade (K-12; corresponding to students ages 5-18 years) school districts in Cass County, North Dakota USA. Fargo Public Schools (FPS) and West Fargo Public Schools (WF) had differing mask policies in the fall of 2021 and the same policy in 2022. Our study takes advantage this unique situation to estimate the association between school mask mandates and student COVID-19 infections. The masks-mandated and masks-optional populations are comparable: their districts are adjacent to each other in Cass County, have similar student enrollment numbers, student demographics, COVID-19 mitigation policies and staff vaccination rates. At the start of the Fall 2021 semester, FPS mandated masks and WF did not.[13] On January 17, 2022, FPS also moved to a mask optional policy,[14] creating a unique natural experiment to study school-based mask mandates.

2 - Methods

The study was conceived in the summer of 2021 based on the knowledge that two adjacent school districts in Fargo North Dakota would be adopting different school masking policies. We obtained data on student enrollment, masking policies, masking compliance, demographic information (race/ethnicity and family income), and COVID-19 mitigation measures from district administrators and official school district websites. We obtained publicly available data on new student COVID-19 case rates in each school district from August 26, 2021, to March 2, 2022, from the North Dakota Department of Health (NDDOH) website.[15] The state department of public health is the official body responsible for COVID-19 surveillance and reporting.[16,17] The raw data used for our analysis are available at the following url: https://github.com/tracybethhoeg/North-Dakota-Mask-Study.[18] County and district level vaccination rates were obtained from the NDDOH. We determined the COVID-19 student case rates and incidence rate ratio (IRR) as well as 95% confidence intervals (CI) for case rates between the districts, both while FPS had a mask mandate and WF did not and then when FPS dropped their mandate on January 17, 2022, after which both districts had mask-optional policies. In both districts, mask-optional policies meant masks were not required for students or staff in any situation on school/district premises but were required on school busses and any school-related public transportation, due to the federal mandate.[13,14]

We opted to extend our initial study period beyond the Fall semester in order to include the time period where both districts had no mask mandate to identify differences in case rates unrelated to masking policy. In particular, the IRR (IRR1) for the period between Fall 2021 and Jan 17, 2022 captures differences in COVID-19 infections between FPS and WP for two reasons: (a) differences in mask policies, (b) other differences in background characteristics across these districts such as average class size or fraction of low-income students. The IRR (IRR2) after Jan 17, 2022 captures differences in COVID-19 infections between FPS and WP due to differences in background characteristics only as the two districts had identical mask policies during this time period. Therefore, comparing the IRRs across two periods allows
us to estimate the potential effect of mask mandates on student COVID-19 infection
rates. In particular, a finding that IRR1 is smaller than IRR2 would suggest that school mask mandates had a protective effect of reducing COVID-19 infections after controlling for differences in background characteristics across districts.

According to the NIH's Human Subjects Research Decision Tool (https://grants.nih.gov/policy/humansubjects/hs-decision.htm), this study was IRB exempt. We used Stata 2021 Version 17 for the main and sensitivity analyses. A post-hoc power calculation was performed using ClinCalc.[19] Staff rate vaccination confidence intervals were calculated using University of California Sample Size Calculators.[20] Our report follows the STROBE reporting guidelines for observational studies.[21]

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Sensitivity Analysis

We performed a sensitivity analysis excluding the period of time during winter break when children were outside of school to minimize the impact of cases acquired in the community over the break in our analysis. In particular, both school districts had winter break from December 23 to January 2. We excluded cases from December 25 to January 6 to allow for a three-day lag from exposure to diagnosis of a case. We also performed the sensitivity analysis to allow for a seven-day lag.

3 - Results

Table 1 shows school characteristics, total number of positive student tests and the COVID-19 risk mitigation measures implemented by each district. Both school districts had similar COVID-19 mitigation policies, although FPS had more stringent rules for quarantining close contacts. WF also had higher percentages of low-income and minority students. Staff vaccination rates by district are shown in Table 1. FPS had a slightly higher, though not significantly so, staff full vaccination rate at 76.1% vs 72.4% in WF. Child vaccination rates were not available at the district level through NDDOH. As of August 29th, the county level vaccination rate of 5-11-year-olds was 0% and for 12-18-year-olds was 39.8% and this increased to 28.1% and 53.4% respectively by February 29th.[22] Vaccination types at the county level through February 29th, 2022 was 76.6% Pfizer-BioNTech, 19.2% Moderna and 4.2% Janssen.[21] Only Pfizer-BioNTech was available to children under 18 years during the study period.

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Table 1: School district characteristics and COVID-19 risk mitigation measures in Fall 2021 in study school districts

School Policies and Characteristics	West Fargo Public School District (School District with mask optional policy)	Fargo Public School District (School district with mandatory masking till Jan 17, 2022; mask optional thereafter to March 1st, 2022)
Student Enrollment in August 2021[a]	12,254	11,419
Total Number (% [95% CI]) of students testing positive[b] up to 1/17/22	1596 (13.0% [12.4, 13.6])	1475 (12.9% [12.3, 13.6])
Total Number (% [95% CI]) of Students Testing Positive After 1/17/22	622 (5.1% [4.7, 5.5])	600 (5.3% [4.9, 5.7])
Average Class Size[c]	21-Elementary School, 23-Middle School, 23-High School	18.7-Elementary School, 21.2 Middle School, 20.1 High School
Race/Ethnicity of Students in 2021-2022 School Year[d]	71% White, 17% African American, Asian 4%, Hispanic 4%	69% White, 16% African American, Asian 4%, Hispanic 6%
Fraction of Low-Income students in 2021-2022 School Year[d]	23% [22.3-23.8]	18% [17.3-18.7]
Staff full vaccination rate at school year start[c]	72.4% (1374/1897) [70.4-74.4]	76.1% (1530/2011) [74.2-77.9]
Staff with at least one dose of vaccination at school year start	74.5% (1414/1897) [72.5-76.49]	77.6% (1560/2011) [75.7-79.4]
Face covering required when using district provided transportation[e]	Yes	Yes
Mandatory physical distancing[d]	No	No
Regular cleaning of high touch surfaces[f]	Yes	Yes
Does the school conduct routine COVID testing of all children? [e]	No. Children are given the option to use a rapid test on certain times and days at school sites. Children need parent permission and need to preregister. Children who develop symptoms at school have the option to test with parent permission when parent picks up child from school.	No. The district has 2 testing sites where students and their families can get tested, but it is voluntary. A parent needs to escort their student to the site or have a permission slip filed in.
On site testing type	BinaxNOW antigen	BinaxNOW antigen
School activities, events, assemblies, and gatherings allowed[e]	Yes	Yes

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Has the school upgraded ventilation systems? [e]	Yes, iMod air filtration units have been installed in every school	Yes, Needlepoint Bi-polar Ionization units have been installed in each school buildings HVAC system.
Symptomatic students sent home[e]	Yes	Yes
How long are COVID+ children required to stay at home? [e]	10 days	10 days
When can symptomatic children return to school? [d]	Students with symptoms other than loss of taste or smell can return when they have been symptom free for 24 hours without use of medications. Students with loss of taste or smell can return after 10 days or the following day after a negative test	Students can return after 10 days from onset or date of negative COVID test whichever is earlier, and free of fever for 24 hours with improving symptoms.
Are children in the same classroom as COVID+ case required to quarantine? [e]	No, a notification is sent to all children in the classroom and parents are asked to monitor their children for symptoms	Not all of them. Only individuals who are close contacts (close contact being anyone within 6ft for 15 cumulative minutes or more in one day) and unmasked (unmasked contacts generally originate from lunch or snack times) are required to quarantine or go through testing protocol to remain in school.
Are "close contacts" required to quarantine? [e]	Only symptomatic individuals or persons who are unvaccinated and unwilling to do a rapid test every other day for seven days need to quarantine	Only unmasked close contacts are required to quarantine or submit to every other day testing to remain in school
Policy exceptions[g]	Pre 1/17 there were temporary mask mandates affecting 0.5% of the student-week observations from WF.[g] Post 1/17 there were temporary mask mandates affecting 2.9% of the student-week observations from WF.[g]	No exceptions. Once FPS initiated the masks optional policy 1/17/22, there was no return to mask mandates

Notes: (a)Information from school district websites. WFPS: https://www.west-fargo.k12.nd.us/site/default.aspx?PageType=3&DomainID=22&ModuleInstanceID=11253&ViewID=644146EE88-D30C-497E-9316-3F8874B3E108&RenderLoc=0&FlexDataID=24239&PageID=37 accessed March 31, 2022. FPS: https://www.fargo.k12.nd.us/page/365 accessed March 31, 2022.
(b)Students only required one positive test to be counted as a case and, per CDC guidelines, a student would not be counted as positive twice within a 90-day period. This was based on https://www.west-fargo.k12.nd.us/cms/lib/ND02203445/Centricity/Domain/2935/Positive%20Cases%20and%20Close%20Contacts.pdf and communication with district staff.
(c)Information from communication with school administrators.
(d)Information from official portal for North Dakota state government. WFPS: https://insights.nd.gov/Education/District/EnrollmentDemographics/09006 accessed March 31, 2022. FPS: https://insights.nd.gov/Education/District/EnrollmentDemographics/09001 accessed March 31, 2022. (e)Information from school COVID-19 protocols. WFPS: https://www.west-fargo.k12.nd.us/cms/lib/ND02203445/Centricity/Domain/2935/COVID%20Health%20and%20Safety%2

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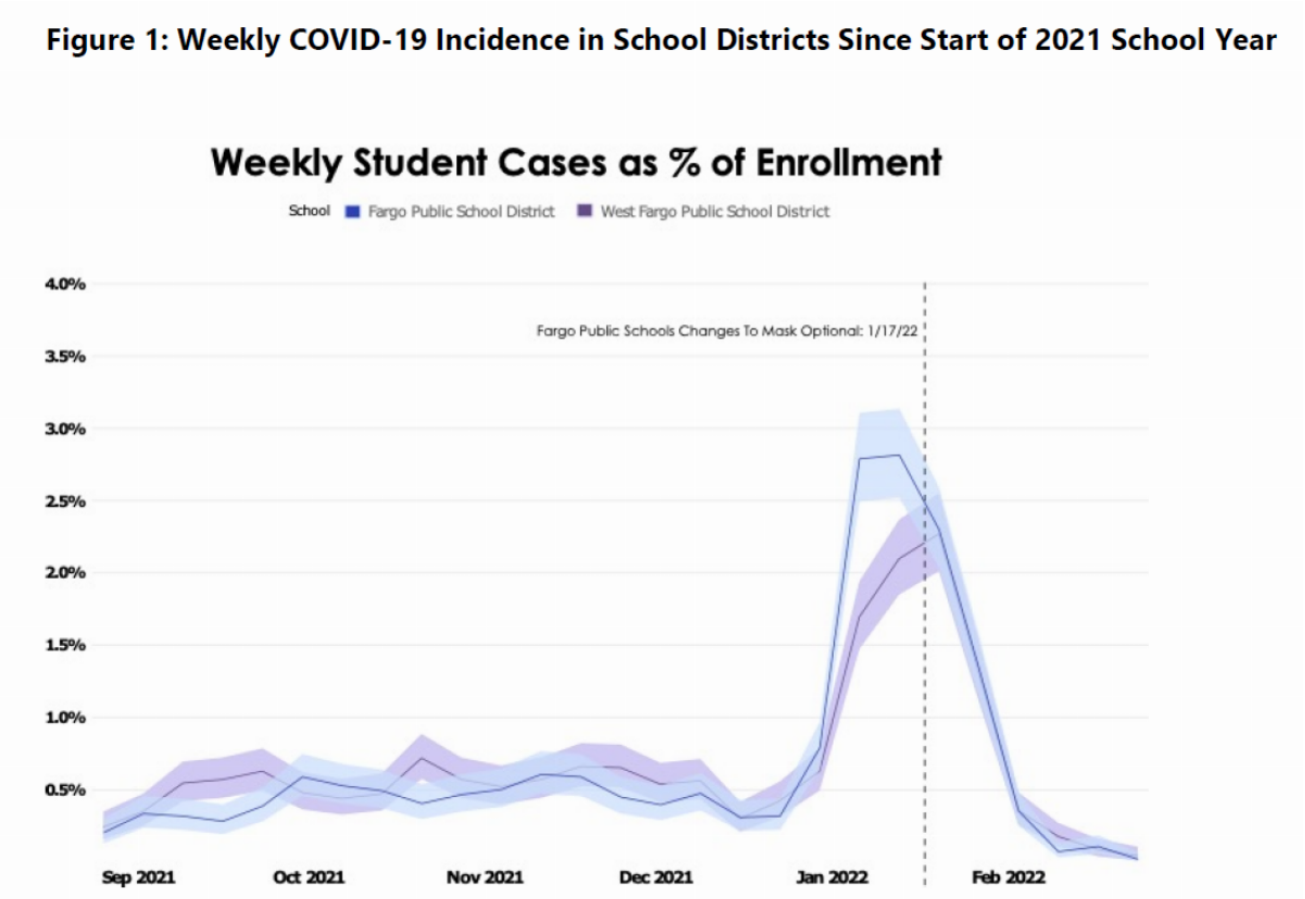
0Protocols%202021-22.pdf accessed March 31, 2022. FPS: https://drive.google.com/file/d/1qyn7DNvCnSuKszHqM8C8BTAixmnCbToS/view accessed March 31, 2022. (f)Personal communication with Brooks Harbor Principle.
(g)Exceptions were based on district recommendations and involved individual school input as described here: https://www.west- fargo.k12.nd.us/cms/lib/ND02203445/Centricity/Domain/2935/COVID%20Health%20and%20Safety%20Protocols%202021-22.pdf. Personal communication with Executive Assistant to the Superintendent and School Board Fargo Public Schools. Details on Schools that reinstated mask mandates with student population in parentheses: Brooks Harbor Elementary (493) 10/25-11/2, Legacy Elementary (481)11/30-12/7 and 1/19-1/28, Horace Elementary (305) 1/20-1/28, with virtual learning from 1/21-1/25, Westside Elementary (411) 1/21-1/29, LE Berger Elementary (372) 1/24-1/30, Harwood Elementary (130) 1/24-2/2, Community High School (61) 1/25-2/3, Transition Academy (30) 1/28-2/4.

FPS had mandatory student and staff masking policy prior to Jan 17, 2022 and dropped the policy thereafter. WF did not have mandatory student or staff masking policy throughout the duration of the study. Reported mask adherence rate from WF was 5% or less via personal communication[23] with the exception of limited number of WF schools, which adopted brief (typically around one academic week) mask mandates affecting 0.5% of the student observations prior to Jan 17, 2022 and 2.9% of the observations post Jan 17, 2022 (See “Policy exceptions” in Table 1).

Figure 1 shows that overall trends in COVID-19 incidence among students were similar in the two districts even when they had different masking policies. From August 26, 2021, to January 17, 2022, cumulative incidence in the mask compulsory school district was almost identical to cumulative incidence in the mask-optional district (WF: 1596/12,254 [13.0%; 95% CI: 12.4, 13.6]); FPS: 1475/11,419 [12.9% 95% CI: 12.3, 13.6%]). IRR 0.99; 95% CI: 0.92, 1.07). From January 17 to February 28, 2022, when both districts had mask-optional policies, case rates were also not significantly different (WF: 622/12,254 [5.1%; 95% CI: 4.7, 5.5]; FPS: 600/11,419 [5.3%; 95% CI: 4.9, 5.7]). IRR 1.04; 95% CI: 0.92, 1.16).

Figure 1: Weekly COVID-19 Incidence in School Districts Since Start of 2021 School Year



Notes: Shaded region represents 95% confidence intervals. Information on new student COVID-19 cases from North

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Dakota Department of Health website available at https://web.archive.org/web/20220125093234/https://www.health.nd.gov/k-12-school-dashboard WFPS: https://www.west-fargo.k12.nd.us/site/default.aspx?PageType=3&DomainID=22&ModuleInstanceID=11253&ViewID=6446EE88-D30C-497E-9316-3F8874B3E108&RenderLoc=0&FlexDataID=24239&PageID=37 accessed March 31, 2022. FPS: https://www.fargo.k12.nd.us/page/365 accessed March 31, 2022. The IRRs across the two periods were also not statistically significantly different (p value = 0.40). Based on an incidence rate of 13%, we had 80% power to detect a 1.2 percentage point difference in incidence or an IRR of 0.91 between the districts.

Results from the sensitivity analysis removing days related to school vacation allowing for three- and seven-day exposure to diagnosis lag showed similar results. IRR during the period when FPS and WF had different masking policies was not statistically different from one [IRR 0.98; 95% CI 0.91 to 1.06]. The IRRs across the two periods were also not statistically significantly different (p value = 0.45).

4 - Discussion

This study found that K-12 school mask mandates were not associated with significantly lower COVID-19 student case rates. This is consistent with adult randomized data on community cloth masking,[10] multiple observational studies of school mask mandates,[1,2,3,6,7] a systematic review of child mask mandates[24] and a systematic review of randomized controlled trials of medical or respirator masking for respiratory illness prevention.[12] While some observational studies have reported a negative association between school mask mandates and SARS-CoV-2 cases,[4,5,8,25] a number of these have faced critique for not being robust to expanding the sample size[7,26] to alternate methods for analyzing the data[7,26] or for clear ecological bias/insufficiently adjusted confounding.[26,27]

The main strengths of our study are 1) the striking similarities between the two districts and 2) the unique opportunity for a crossover period within the study. First, similarities of the two K-12 districts include size, adjacent location within the same county, similar demographics, and COVID-19 policies beyond masking. Second, the partial crossover design (similar to a difference-in-difference design) with the mask mandate district (FPS) dropping its mandate during the study period, served as a control for time invariant observable or unobservable differences in COVID-19 policies or other background characteristics across the two districts. Any significant confounding created by differences in background characteristics such as average class size or fraction low-income population should have been apparent in the crossover period, but no difference was observed.

Our study had 80% power to detect a 1.2 percentage point (IRR 0.91) difference in incidence between the districts, so if we failed to detect a benefit of mask mandates, that benefit would have been modest. An additional strength of this study is it includes a relatively long study period with data from both the delta and omicron waves. There was a large spike of cases during the omicron wave, part of which occurred over the winter break. We performed two sensitivity analyses removing the winter break period and failed to find any difference in our outcome.

The study also has limitations. We did not have information on the number of tests performed by each school district. However, in both districts rapid testing was available but was voluntary. There was a discrepancy in quarantine policies where WF required unvaccinated students to test every other day for 7 days, FPS only required this of unmasked students, which may have increased the testing rate at WF in relation to FPS owing to a higher likelihood that a student was unvaccinated at WF than unmasked at FPS, but this would have given a false appearance of higher cases in the unmasked district, but did not. Furthermore, if overall testing rate had been a major confounding variable, we should have seen a difference between the groups in the period of time when neither district had a mask mandate.
Both districts upgraded their air ventilation systems for COVID-19, though had installed different types of units. A recent systematic review failed to find robust evidence of benefit of air filtration systems against respiratory infections[28] though randomized data are still lacking. However, any confounding created by air filtration differences should have been apparent in the post-January 17th, 2022 period when both districts had the same mask policy.

Second, this study did not specifically evaluate in-school transmission and we were thus only able to look for correlation between mask mandates and overall student infection rates. We also did not have data on the types of masks being worn or on masking adherence rates in the two school districts; however, parents and administrators indicated via personal communication with SH, masking was near universal in the district with a mask mandate and 5%

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or less in the masks-optional district.[23] This was thus not a study of mask effectiveness but of correlation between school mask mandates and student cases. We could not assess the effectiveness of a mask on a particular individual or evaluate different types of masks.

Third, we do not have information on severity of cases thus cannot evaluate if mask mandates were associated with disease severity. We are not able to control for community case rates among adults because these districts are within the same county and only county level case rates are reported. Although we found no association between school mask mandates and COVID-19 student cases, we are unable to determine if certain masks may offer protection in certain situations. For example, our findings may not be applicable to brief encounters and/or those with fitted N95 respirator masks.

Fourth, though our natural experiment design with a partial crossover period offered a unique way to detect the presence of relevant confounding variables, we are not able to entirely rule out the presence of confounding in our results. For example, we were unable to entirely rule the appearance of new or time-varying confounders, such as changes in testing rates or immunity levels occurring at or around the same time as the FPS mask policy change in January, 2022, which may have hidden evidence of prior confounding. Furthermore, a limited number of WF schools (0.5% of student-week observations) adopted temporary mask mandates in response to a rise in cases pre-January 17th (Table 1) and we are unable to say if masks prevented additional rises in case rates in these specific schools. Finally, WF and FPS students and staff regularly interacted in sport, extra-curricular and social activities and our study design did not permit us to isolate which transmission occurred within the school setting vs after school or on the weekends.

The results of our study are consistent with two other natural experiments of school mask mandates in children[3,6] and the pooled results of randomized trials of masking in the community and healthcare setting to prevent respiratory viruses. Notably, the randomized trials included almost exclusively adults.[12] Randomized trials in school settings have not been performed but could have minimized the opportunity for bias even further than the published natural experiments.

Masking recommendations for children have varied dramatically worldwide since 2020. The European CDC did not recommend masking for children under 12 years while the US CDC continues to recommend masking for children starting at two years in certain circumstances.[29,30] Concerns about harm to children include, but are not limited to, detrimental effects on speech, comprehension, emotional health as well as physical discomfort and discouragement of physical activity and should be considered in the context of the current lack of high-quality evidence of benefit.[24,30]

In conclusion, school mask mandates were not found to be associated with significantly lower student SARS-CoV-2 case rates in our study. While randomized trials of masking in this setting have not been reported, the findings of our unique natural experiment are consistent with a growing body of scientific literature and should be taken into consideration and weighed with the potential harms and discomfort of masking in the educational setting.

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Peer Review of: School Mask Mandates and Student SARS-CoV-2 Infections: Evidence from a Natural Experiment of Neighboring K-12 Districts in North Dakota, USA

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For adults, two well designed randomized trials have shown that face masks have only a marginal or no effect at reducing Covid-19 transmission. The Bangladesh study that randomized villages showed a reduction somewhere between 0 and 18 percent [1], while the DANMASK-19 study that randomized individuals showed an effect size between a 46 percent reduction and a 23 percent increase [2]. This is similar to other respiratory diseases [3,4].

There is much less data available for children, with no randomized mask studies for Covid disease, so it is important to conduct observational studies. That is what Nood et al have done in this well described study, using a natural quasi-experiment from two neighboring school districts in North Dakota [5].

For children, one of the best observational mask studies used another natural quasi-experiment in Catalonia, where Coma et al. compared 5-year-old children that were not masked with 6-year-old children that were [6]. As with adults, they found no major benefit on Covid infections, with a marginal increased infection risk for the masked 6-year-olds of between 8 and 22 percent. That is in the same ballpark as the current study by Nood et al., who report an effect size somewhere between an 8 percent decrease and a 7 percent increase.

A key issue in these four studies is the effective sample size. Since the Danes randomized individuals, the sample size was the number of individuals, and the analysis was done at the level of individuals. As a contrast, since they randomized villages in Bangladesh, that analysis was appropriately performed at the village level. For a variety of reasons and just by chance, some villages will have more Covid infections than other villages during the study period, so individuals in the same village are not independent observations. This means that the effective sample size is the number of villages.

In the Catalonian study, the 5 and 6-year-olds are mixed geographically, living in the same neighborhoods. If the disease is more widely present in one neighborhood than another during the study period, that should affect the 5^{th} and 6^{th} graders equally. Hence, the effective sample size is the number of children, and the analysis should be conducted at the level of individuals. With higher Covid incidence for older children, age is a confounder, but the difference between the 5 and 6-years olds was about the same as the differences found between the 4 and 5-years-olds, who did not wear masks, and between the 6 and 7-year-olds, who all wore masks.

What about the current study in North Dakota? The two adjacent school districts are in the western versus central part of the Fargo-Moorhead Metropolitan Area. Hence, the children are not geographically mixed as they were in the Catalonian study. When an infectious disease spreads through a city, it will typically affect one area at first, after which it moves on to other neighborhoods. One could therefore argue that the effective sample size is the number of school districts rather than the number of individuals, and that the analysis should be conducted at the level of school district rather than individuals.

Having adjacent school districts is better than using two school districts far apart, but the ideal would have been to use multiple pairs of neighboring school districts and to analyze the data at the level of school districts. With a sample size of only two school districts, such an analysis would have been too small to make any precise conclusions either way.

For an analysis at the individual level, geography is a plausible confounder. The null result of no effect could either be because masks have no or limited effect, as shown by other studies. Alternatively, it could be because mask wearing Fargo schools had more Covid circulating during the study period and that masks were effective at bringing the incidence down among school children, with the two effects canceling each other.

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What we can conclude from this study is that wearing face masks at school does not provide 100% protection against Covid infections in children. If that was the case, there would have been very few Covid infections in the Fargo school district during the mask-mandate period. For more precise conclusions, we must rely on other observational and randomized studies.

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Peer Review of: School Mask Mandates and Student SARS-CoV-2 Infections: Evidence from a Natural Experiment of Neighboring K-12 Districts in North Dakota, USA

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This paper presents and analyzes a natural experiment on face masking as an anti-covid measure. It is a welcome addition to the literature on covid. The authors' conclusions are supported by the data they present.

Natural experiments have been a cornerstone of public health research since John Snow's "On the mode of communication of cholera," which examined cholera mortality in Victorian London, by water source. The key to Snow's study is that water sources changed in a way that was so haphazard that it was essentially random, and was blind to the unwitting participants. This paper follows in that long tradition.

The authors follow covid incidence in two adjacent school districts in North Dakota in the 2021-22 school year. Crucially, the two districts are very similar in social and demographic characteristics, and differed principally in mask policy. The Fargo Public School District did not have a masking policy, while the West Fargo Public School District did, until 17 January 2022, when it switched to masking optional. There was no statistical difference in covid incidence between the school districts. The authors conclude that there is no association between mask policy and covid case rates in this natural experiment.

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First, some comments particular to this study, then I will add some context. The authors are circumspect in their conclusions and statements. They never claim that masking is not effective in any setting or for any purpose. The paper is about covid incidence in two school districts, and the authors stay close to the evidence. As I have already noted, I believe the authors' conclusions agree with their data. To put it in plain English: the mask mandate in the Fargo School District didn't buy its pupils any protection against covid compared to the neighboring West Fargo Public School District.

One question I had was that in table 1, the race/ethnic composition percentages total 96% and 95%; I assume this is some combination of rounding by category and the fact that Native American is not enumerated. More importantly, I wonder if there might be differences in case detection across the two districts. The study usefully points out that both districts used the same covid tests, which removes one possible mechanism of difference. However, the crux of the matter here is that natural experiments are not drop-in replacements for randomized experiments. The error term may be correlated with the exposure, namely the two districts self-selected into quite different masking policies, and may have had different testing avidity. They also had different return-to-school policies (cf. authors' table 1). This is one area in which this study differs from Snow's essentially random study, as mentioned above. Also, maskers are never blind to their own masking. Frankly, I don't think such phenomena drives these results, but it's worth noting that it may have contributed. I think school mask mandates in the real world, with actual masks as used by real people, just didn't work as well as it had been hoped when the mandates were planned.

Big picture, what should we extrapolate from these findings? The authors don't comment much, but I am at liberty to do so. The next pandemic of respiratory infectious disease (may it never arrive!) could have different transmission parameters than covid did in academic year 2021-22 in North Dakota. As such, saying that masks *never* work, based on this paper, would be throwing the baby out with the bathwater. To be clear, the authors don't say this; I'm setting up a deliberate strawman. Nonetheless, I think the public health community should keep in mind this and other studies as it draws up plans for dealing with future pandemics. Different pandemics are, well, different, and perhaps school masking can help stem the tide in the next pandemic. However, and this is key, such a decision will have to be made in light of a prior that it did not work in covid in 2021-22. Thus, the stakes will have to be even higher, or the certainty greater that something is different.

Do masks work, *at all*? For example, will wearing masks when attending an indoor sporting event protect the wearer, on a one-off basis? The present study doesn't put that to the test. These are a suite of a questions which will likely require a suite of studies to answer, with each study being tailored to the applications. Natural experiments, as this one, may be harder to find for every application.

Covid is still with us; it is endemic now; people can and do argue about what endemicity means but I think it's noncontroversial to say that covid is endemic. Should we mandate mask in schools now? Well, no; per above. Moreover, masks were meant as temporary crisis management during the pandemic phase. One thing we can do is improve indoor air quality; this should be subject to experimentation as well, and is amenable to randomized experiment (schools get retrofitted for air improvements, or not, at random). In the wake of John Snow's work, drinking water supplies were cleaned up; civil engineering projects at enormous monetary cost. It remains to be seen if the covid pandemic will make any lasting changes to indoor air quality, but asking schoolchildren to don masks at the sign of the next pandemic should not be counted on to save the day.

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